Insulating tape for wrapping an electrical conductor

The invention relates to an insulating tape for wrapping an electrical conductor with a fabric which is used as the supporting body with warp threads which are routed in the direction of winding, consisting of a first yarn, and with woof threads of a second yarn which is finer than the first yarn and with a dielectrically high quality material which is applied to a fabric. One such tape is wound around an electrical conductor to insulate the winding of an electrical machine, then impregnated under a vacuum and pressure with an impregnation resin and afterward cured as it is supplied to a tank.

Prior Art

An insulating tape as claimed in the preamble of claim 1 can be taken for example from DE 38 24 254 A and EP 0 194 974 B. This insulating tape contains a mechanically fixed supporting body of glass silk fabric with a weight per unit area of typically 20 to 40 g/cm^2 and a layer of dielectrically high quality material which is applied to this fabric, for example fine mica or mica paper, with a weight per unit area which is a multiple of the weight per unit area of the fabric. The proportion by weight of the dielectrically high quality material determines the quality, especially the breakdown strength, of insulation produced from the insulating tape.

Preferred glass silk fabrics for insulating tape have weights per unit area of roughly 25 g/cm^2 and roughly 33 g/cm^2. The lighter fabric is formed by warp and woof threads from a yarn with a thread weight of roughly 5.5 tex (mass in g per 1000 m thread length), conversely the heavier fabric has woof threads of yarn with a thread weight of roughly 5.5 tex and warp threads of a coarser yarn with a thread weight of roughly 11 tex.

The tensile strength of the lighter fabric in the direction of the warp threads is roughly 70 N/cm, that of the heavier fabric, roughly 130 N/cm. In the manufacture of insulation the warp threads are pointed in the direction of winding. Since the heavier fabric has a higher tensile strength in the direction of winding than the lighter fabric, an insulating tape which contains the heavier fabric can be wound with a higher speed, without the tape tearing in doing so. In any case, due to the higher proportion by weight of fabric in the insulating tape the breakdown strength of the insulation is then less than the breakdown strength of insulation of equal thickness, made of an insulating tape which contains the lighter fabric.

Description of the Invention

Therefore the object is to devise an insulating tape of the initially mentioned type which has a low proportion of fabric and still is characterized by high tear resistance.

The insulating tape as claimed in the invention, due to the low proportion of fabric, is outstandingly well suited for producing dielectrically high quality insulations, thus as they were produced in the past from an insulating tape with a light glass fabric of fine yarn. Since the comparatively coarse yarn which is used in the insulating tape as claimed in the invention in the warp threads of the fabric has only a low thread density, the fabric portion of this tape can be kept essentially as great as that in the aforementioned insulating tape with light glass fabric. Moreover, the thickness of the coarser yarn used in the warp threads does not adversely affect the dielectric properties of the insulating tape as claimed in the invention or the insulation produced accordingly, since on the one hand the doubling of the thread weight causes only a thickening of the thread diameter by a factor of 1.4, and since on the other hand the thick threads flatten during winding due to

the low thread density.

In addition, the insulating tape as claimed in the invention is characterized mainly in that during winding it can be loaded like an insulating tape which contains as the supporting body for the dielectrically high quality material a heavy fabric with warp threads of coarser yarn which have been plaited with a narrow mesh. This technical effect was undoubtedly surprising since the property of tensile strength of the insulating tape to be wound, which is important in winding, in the insulating tape as claimed in the invention due to the small number of warp threads is not greater than in an insulating tape with fabric of the same weight and with a large number of warp threads of finer yarn. But it was ascertained that when wrapping an electrical conductor which generally has a rectangular or quadratic profile, not only the tensile strength is important, but mainly the edge tear initiation strength. The warp threads do not tear jointly during winding, but proceeding from one edge of the tape which has been laid down on the conductor, thread by thread. Therefore the strength of the individual warp threads is of special importance for the tear strength of the insulating tape. By using few, but relatively thick and thus tear-proof warp threads a fabric construction was achieved which meets the requirements for a light fabric which is resistant to initiation of edge tearing.

In addition, the insulating tape as claimed in the invention is made relatively coarsely meshed and is accordingly characterized by comparatively high porosity. This high porosity greatly facilitates and accelerates the impregnation of the wound insulating tape with impregnation resin.

Advantageous developments of the insulating tape as claimed in the invention are given in the dependent claims.

One preferred embodiment of the invention is described below

Embodiment of the Invention

For wrapping an electrical conductor with a rectangular profile, three insulating tapes were produced. These insulating tapes each contained as the supporting body a glass silk fabric of varied structure and a mica paper cemented to the fabric with a weight per unit area of 180 g/m^2. These three insulating tapes were each cut out from roughly 1 m wide insulating tape webs in a width of roughly 25 mm in the warp direction (direction of winding). Then the tensile strength, the edge tear initiation strength (tear strength of a insulating tape which is supported on this edge and which is guided obliquely to one edge of the conductor) and the porosity (after Gurley Hill) were determined on these three insulating tapes. These quantities are important in the wrapping of an electrical conductor and in the impregnation of the wrapped conductor with impregnation resin. The structures of the glass silk fabrics which belong to the three insulating tapes and the aforementioned properties of the three tapes are summarized in the following table.

Insulating tape		1 (Prior art)	2 (Prior art)	3 Invention
Weight per unit area,	g/cm²	23	33	24
Warp thread weight,	tex	5.5	11	11
Woof thread weight,	tex	5.5	5.5	5.5
Thread density, warp threads,	per cm	27	24	16
Thread density, woof threads,	per cm	15	11	10
Tensile strength in warp direction,	N/cm	80	140	104
Edge tear initiation strength,	N	8	16	8
Porosity, glass side,	s/100 ml	100	180	100

It is clear from this table that in contrast to the insulating tapes 1 and 2 which are considered prior art, in insulating tape 3 the warp threads are formed by a coarse yarn and have a low thread density. This yields a coarse-mesh fabric with a weight per unit area which corresponds to the weight per unit area of the fine-mesh fabric according to insulating tape 1 which contains warp and woof threads of finer yarn. In contrast to this fabric, the fabric of the insulating tape however has an edge tear initiation strength which is twice as high. The fabric of the insulating tape 2 has a comparatively high edge tear initiation strength, but it is much heavier so that insulation produced using it has a much lower dielectric strength than the correspondingly made insulation from the insulating tape 3.

To avoid an overly large weight per unit area and an overly great thickness of the fabric with high edge tear initiation strength, it

is recommended that predominantly yarns be used with a thread weight which is acts roughly like 2 to 1. At a weight per unit area of the fabric between 20 and 28 g/cm^2 the thread density of the warp threads should be 10 to 20 threads per cm. The insulating tape 3 can then be exposed to an edge tear initiation force between 12 and 18 N.

Commercial applicability

As can be taken from the table, the insulating tape 3 has a porosity almost twice as high as that of the insulating tape 2 which is considered prior art and which is comparable in terms of weight per unit area. Therefore, in the production of an insulated conductor after wrapping the conductor it can be impregnated very quickly with impregnation resin and in this way the production time can be greatly reduced.

The insulating tape as claimed in the invention furthermore has a low proportion of fabric and thus good dielectric properties with simultaneously high edge tear initiation resistance. Accordingly the electrical conductors can be wrapped with high winding speeds using the insulating tape as claimed in the invention.